

PENDING CLAIMS

1. (previously presented) A method for improving the water injectivity of an injection well in a petroleum containing formation by restoring the permeability of said petroleum-containing formation thereby enhancing the recovery of oil by the waterflood process, said method comprising treating said formation with a composition which comprises at least one nonionic surfactant and at least one cationic surfactant in an amount and a concentration effective to improve the permeability of said formation, wherein said at least one nonionic surfactant is selected from the group consisting of alkanolamides, alkoxylated alcohols, alkoxylated amines, alkyl phenyl polyethoxylates, lecithin, hydroxylated lecithin, fatty acid esters, glycerol esters and their ethoxylates, glycol esters and their ethoxylates, esters of propylene glycol, sorbitan, ethoxylated sorbitan polyglycosides and mixtures thereof, and said at least one cationic surfactant is an ethoxylated quaternary ammonium compound.

2. (canceled)

3. (previously presented) The method of claim 1 wherein said at least one nonionic surfactant is an ethoxylated linear or branched alcohol of the formula:



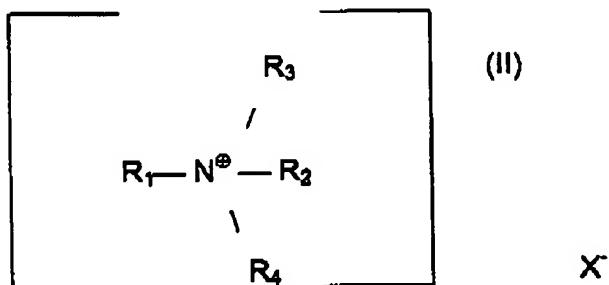
wherein R is a C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl, or alkylphenyl group of the formula A -  - O(CH₂CH₂O)_z, wherein A is a C₈-C₃₀ saturated or unsaturated, branched or straight chain alkyl, preferably a C₉-C₁₂ linear or branched alkyl, and z is an integer of from 1 to 30.

4. (previously presented) The method of claim 3 wherein A is a saturated or unsaturated, branched or straight chain C₉-C₁₂ alkyl.

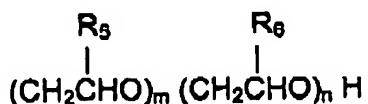
5. (original) The method of claim 3 wherein said ethoxylated alcohol is selected from the group consisting of lauryl alcohol ethoxylated with 3 moles of ethylene oxide(EO), coco alcohol ethoxylated with 3 moles of EO, stearyl alcohol ethoxylated with 5 moles of EO, mixed C₁₂-C₁₅ alcohol ethoxylated with 7 moles EO, mixed secondary C₁₁-C₁₅ alcohol ethoxylated with 7 moles EO, mixed C₉-C₁₁ linear alcohol ethoxylated with 6 moles EO, a C₉-C₁₁ alcohol ethoxylated with 4 moles EO, and mixtures thereof.

6. (canceled).

7. (previously presented) The method of claim 1 wherein said at least one cationic surfactant is an ethoxylated quaternary ammonium compound of the general formula:



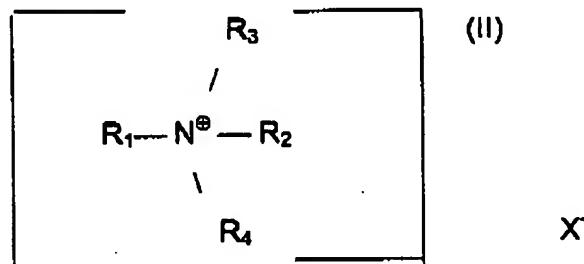
wherein R₁ is an saturated or unsaturated, branched or straight chain alkyl group having 8-22 carbon atoms; R₂ is a C₁ to C₆ alkyl group, 2-ethylhexyl, hydroxyethyl, hydroxypropyl; R₃ is a group of the formula:



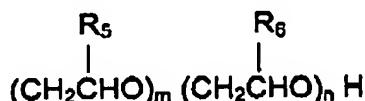
wherein R₅ and R₆ independently selected from hydrogen or a C₁ to C₆ alkyl group, and m + n is an integer of from 2-80; R₄ is selected from R₂ or R₃; and X⁻ is an anion.

8. (previously presented) The method of claim 1 wherein said composition comprises a combination of

- (i) at least one ethoxylated linear or branched alcohol having from 8 to 18 carbon atoms reacted with 2 to 12 moles of ethylene oxide;
- (ii) at least one quaternary ammonium compound of the general formula:



wherein R₁ is an saturated or unsaturated, branched or straight chain alkyl group having 8-22 carbon atoms; R₂ is a C₁ to C₆ alkyl group, 2-ethylhexyl, hydroxyethyl, hydroxypropyl; R₃ is a group of the formula:



wherein R₅ and R₆ independently selected from hydrogen or a C₁ to C₆ alkyl group, and m + n is an integer of from 2-80; R₄ is selected from R₂ or R₃; and X⁻ is an anion, and

- (iii) up to 30% by weight of at least one (poly) alkyl glucoside.

9. (original) The method of claim 8 wherein said ethoxylated alcohol is selected from the group consisting of lauryl alcohol ethoxylated with 3 moles of ethylene oxide(EO), coco alcohol ethoxylated with 3 moles of EO, stearyl alcohol ethoxylated with 5 moles of EO, mixed C₁₂-C₁₅ alcohol ethoxylated with 7 moles EO, mixed secondary C₁₁-C₁₅

alcohol ethoxylated with 7 moles EO, mixed C₉-C₁₁ linear alcohol ethoxylated with 6 moles EO, a C₉-C₁₁ alcohol ethoxylated with 4 moles EO, and mixtures thereof.

10. (previously presented) The method of claim 8 wherein R₁ is coco alkyl, m+n = 15, R₂ is methyl, R₅ and R₆ are both H and X⁻ is Cl⁻ or methylsulfate.

11. (original) The method of claim 8 wherein said quaternary ammonium compound is selected from the group consisting of stearyl methyl bis(ethoxy) ammonium chloride (12 moles EO), stearyl ethyl bis(ethoxy) ammonium ethyl sulfate (15 moles EO), tallow methyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), tallow ethyl bis(ethoxy) ammonium methyl sulfate (15 moles EO), hydrogenated tallow methyl bis(ethoxy) ammonium chloride (15 moles EO), coco methyl bis (ethoxy) ammonium chloride (20 moles EO), and mixtures thereof.

12. (original) The method of claim 8 wherein the HLB of the quaternary ammonium compound is from about 14.00 to 22.00.

13. (original) The method of claim 8 wherein said composition additionally comprises up to 30% of a (poly) alkyl glycoside of formulae III or IV:



wherein R₄ is a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, G is a monosaccharide residue and x and y are selected from a number of from 1 to 5;



wherein R₄ is a straight or branched chain alkyl or alkenyl group having from 8 to 21 carbon atoms, R₅ is hydrogen or a straight or branched chain alkyl or alkenyl group

having from 8 to 21 carbon atoms, G is a monosaccharide residue and x and y are selected from a number of from 1 to 5.

14. (original) The method of claim 1 wherein said composition additionally comprises one or more solvents.

15. (previously presented) The method of claim 14 wherein said solvent is selected from the group consisting of water, lower alcohols, glycol ethers and mixtures thereof.

16. (original) The method of claim 15 wherein said solvent is selected from the group consisting of methanol, ethanol, 1-propanol, 2-propanol and the like, glycols such as ethylene glycol, propylene glycol, diethylene glycol, dipropylene glycol, polyethylene glycol, polypropylene glycol, polyethylene glycol-polyethylene glycol block copolymers, and mixtures thereof.

17. (original) The method of claim 1 wherein the ratio of said at least one nonionic surfactant to said at least one cationic surfactant is in the range of 4:1 to 1:4.

18. (original) The method of claim 17 wherein said composition comprising said at least one nonionic surfactant to said at least one cationic surfactant is diluted to a concentration of from about 0.1% to about 10% by weight prior to injection into the formation.

Claims 19-29 canceled.